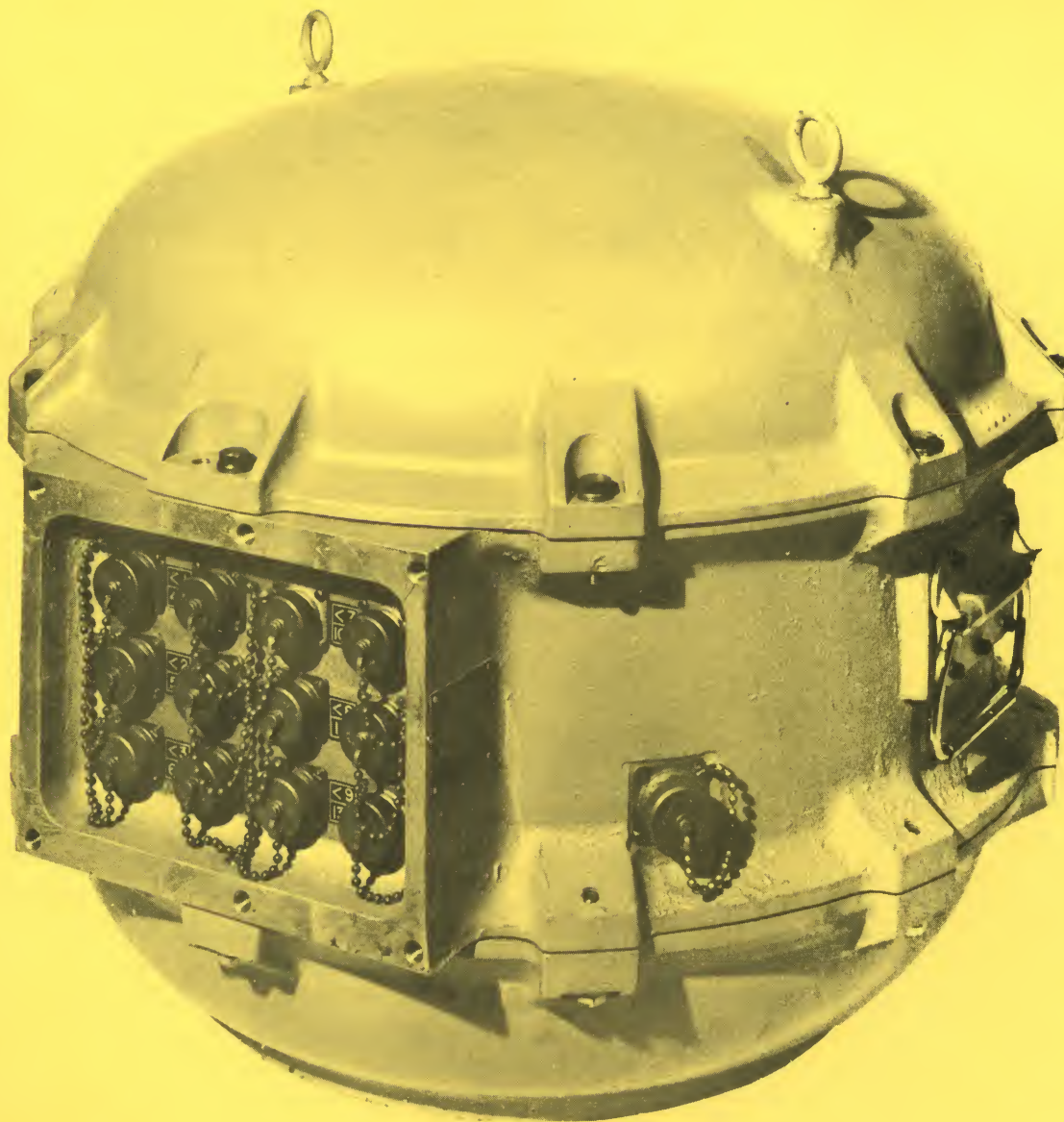


DAQ - PAC



GENERAL AMERICAN RESEARCH DIVISION

GENERAL AMERICAN TRANSPORTATION CORPORATION

7449 NORTH NATCHEZ AVENUE, NILES, ILLINOIS 60648 312/647-9000

DAQ-PAC
HARDENED INSTRUMENTATION SYSTEM

I. Description

DAQ-PAC is a self contained portable data acquisition package designed for field measurements under severe shock, overpressure, nuclear radiation and electromagnetic pulse environments. The system was developed under an Air Force Weapons Laboratory contract for operation in close proximity to the sensors to minimize the length of signal cables. Present unhardened data systems require a special protective enclosure when close-in or alternatively, long cable lengths to reach a remote protective area. Either approach involves considerable installation time and cost, and long lines are extremely vulnerable to EMP and ground motion. Designed for close-in operation in the area of 500 PSI overpressure, the DAQ-PAC is not as susceptible to these effects.

The DAQ-PAC consists basically of two parts: (1) a signal conditioning section which provides excitation voltages for transducers, automatic calibration, bridge balance, bridge completion and a balanced differential pre-amplifier to provide adequate signal levels for recording; and (2) an analog magnetic tape recording system for recording in both direct and FM format per IRIG specification 106-60.

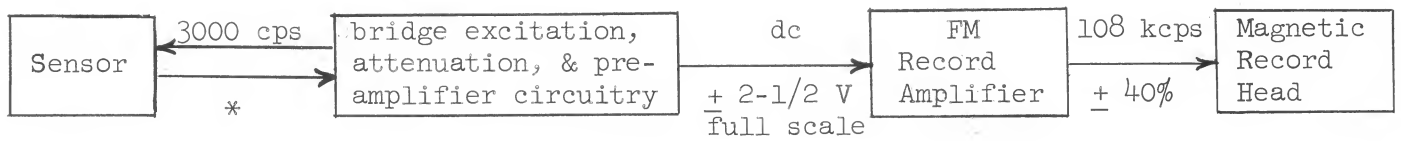
All components of the system are plug-in modules allowing the use of a wide variety of transducers to obtain magnetic tape recording of data without additional circuitry. After the data has been recorded, the tape is recovered and played back on any standard IRIG magnetic tape playback system. A total

of twelve data channels plus two channels for flutter compensation and time reference data are provided.

The DAQ-PAC also contains a programmer, electromagnetic pulse (EMP) input circuit protection and internal power supply. Upon activation by external control signals, the programmer automatically directs the DAQ-PAC through a series of operations including pre-test warmup and calibration, shorting input lines for EMP protection, data measurement and recording, and post test calibration. Thus the DAQ-PAC is a complete instrumentation system and requires no external support other than initial activation. The high shock and nuclear radiation resistance has been obtained by an all solid state design and the careful selection of components.

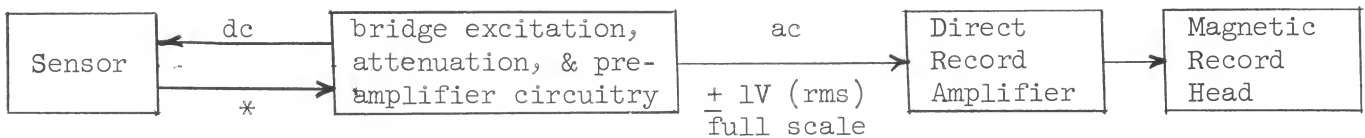
II. Modes of Operation

The DAQ-PAC features broad flexibility for measurement purposes, made possible through extensive use of modular construction. A combination of modules or cards are provided which allow measurements of low frequency phenomena (0-600 cps) using a 3 kc carrier for transducer excitation, or wide band linear (200-200,000 cps) processing for applications requiring high frequency response. Wide band recording over the range of dc to 20,000 cps is also available as an optional feature for those applications where both relatively high frequency response and dc levels must be recorded. Tape speeds in the range of 3-3/4 ips to 60 ips can be provided depending on the frequency response requirements. The corresponding recording times range from 60 to 4 minutes respectively. The different modes of operation possible at 60 ips tape speed for each data channel are shown in the following diagrams.



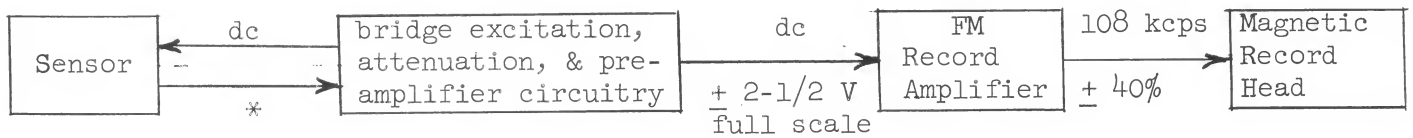
* modulated 3000 cps
 + 1-1000 mv full scale

a. narrow band carrier channel



* 200-200,000 cps
 + 1-1000 mv full scale

b. wide band ac channel



* 0-20 kcps
 + 10-1000 mv full scale

c. wide band dc channel

III. Physical Layout

The DAQ-PAC is comprised of four major subassemblies, the electronics compartment, the tape transport, the battery pack and the external container. The latter forms the fixture to which the other subassemblies are mounted; in

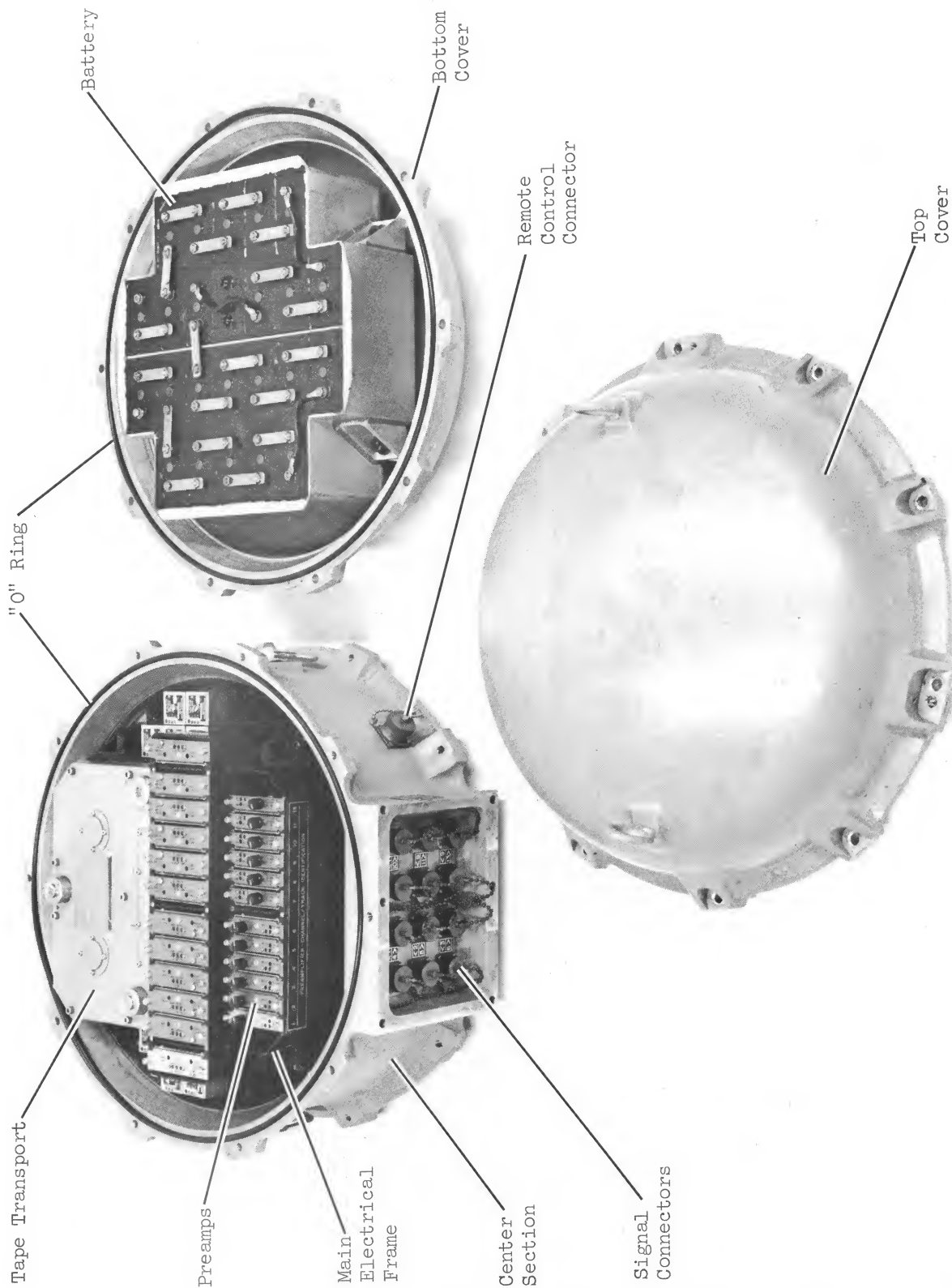


Figure 1 MAIN CONTAINER - DISASSEMBLED

addition it affords the necessary environmental protection against EMP, overpressure and moisture. A boss is provided to mount a cable strain relief to minimize cable breakage from motion of the DAQ-PAC due to the environment. Shaped as an oblate sphere, the container is constructed of 5/8 in. thick aluminum in three pieces; the center section and the top and bottom covers. (See Figure 1) Each cover is bolted to the center section with ten studs which can be quickly removed for access to the inside or rapid data recovery.

The electronics compartment and tape transport, which form the heart of the system, are hard mounted to the center section as a package. This assembly has been designed so that all the data channel modules such as the preamplifiers, and record electronics are exposed at the top and are accessible for balancing, adjustment and replacement when the top cover is removed. Similarly, the entire tape transport can be quickly removed from the top for rapid recovery of the recording medium in the field.

The battery pack consists of a potted assembly of rechargeable nickel cadmium batteries and is secured to the bottom cover. It is coupled to the electronics and transport through cables with connectors.

For airborne or space applications the electronics and tape recorder can be removed as a package from the central section of the container and mounted elsewhere with no reduction in shock and radiation resistance. This affects a large savings in weight, particularly if the internal battery can be eliminated by substitution of the vehicle electrical power.

IV. Specifications

Performance Characteristics

Accuracy	- $\pm 2\%$ of full scale FM mode $\pm 5\%$ of full scale FM mode under specified environment
Tape Speed	- Standard 3-3/4 through 60 inches/sec.
Tape Width	- 1 inch
Recording Time	- 4 minutes @ 60 ips
Track Numbering & Spacing	- per IRIG Specification 106-60 (Analog)
Recommended Tape	- 3M Tape 951-1
Start-Stop Time	- 1.0 seconds maximum
Tape Speed Accuracy	- 0.5% from nominal @ 60 ips
Flutter	- < 1.0% peak to peak dc to 300 cps @ 60 ips
Calibration	- automatic 0 and single shunt
Frequency Response and Input Impedance	- see plug-in modules
Transducer Connection	- Standard 4 wire system under environment. 6 wire remote calibration for long lines in absence of EMP.

Operating Environmental Specifications

Shock	- 100 g's, 1/2 sine wave, 11 ms duration
Neutron Radiation	- 10^{13} NVT (Preamps and record electronics - 10^{14} NVT)
Gamma Radiation	- 10^8 rad C/sec intermittent, recover 0.1 ms 10^6 rad C/sec continuous
EMP	- 16,000 ampere turns/meter magnetic field 5,000 volts/meter electric field 5KC-25 KC
Temperature	- -20°C to +55°C
Overpressure	- 500 psi minimum
Moisture	- Waterproof - 150 psi hydrostatic pressure

Physical Specifications

- | | |
|--------|--|
| Size | - 24-1/4 inch diameter oblate sphere
20-1/2 inches high |
| Weight | - 275 pounds |

PLUG-IN PREAMPLIFIERS

Wide Band Preamplifier - Model 1053

- | | |
|-----------------------|---|
| Input Voltage | - 1 mv rms for 1 Volt output |
| Step Attenuator | - X0, X1, X10, X100 |
| Input Impedance | - 25,000 ohms, X0, 50,000 ohms all other settings |
| Signal to Noise Ratio | - 30 db |
| Frequency Response | - 200 cps to 200 Kcps $\pm$ 1 db |
| Bridge Excitation | - 0-10 Volts dc 1 watt |
| Adjustments | - attenuation, amplifier gain, bridge voltage, and bridge balance |

Carrier Preamplifier - Model 1054

- | | |
|-----------------------|---|
| Input Voltage | - 1 mv rms for 2.5 Volts dc output |
| Step Attenuator | - X0, X1, X10, X100 |
| Input Impedance | - 1500 ohms minimum |
| Signal to Noise Ratio | - 30 db |
| Carrier Frequency | - 3 Kcps |
| Frequency Response | - 0-600 cps $\pm$ 1 db |
| Bridge Excitation | - 3 KC, 1-10 Volts RMS, 1 watt |
| Adjustments | - Attenuation, amplifier gain, bridge voltage, and bridge balance |

* D.C. Preamplifier - Model 1062

- | | |
|----------------------------|--|
| Input Voltage | - 5 mv for 2.5 volts output |
| Maximum Peak Input Voltage | - $\pm$ 2.5 volts |
| Gain Stability | - $\pm$ 1% after 5 minute warmup |
| Step Attenuator | - X0, X1, X10, X100 |
| Maximum Source Resistance | - 1000 ohms |
| Frequency Response | - dc to 20 Kcps |
| Bridge Excitation | - 0-10 volts dc 1 watt |
| Adjustments | - Attenuation, amplifier gain, bridge voltage and bridge balance |

* Tentative specification - Final specifications will be established upon completion of development program.

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PLUG-IN RECORD ELECTRONICS

FM Record - Model 1067

Input Voltage	- ± 2.5 Volts for $\pm 40\%$ deviation
Frequency	- 108 KC $\pm 40\%$ (60 ips)
Frequency Response	- dc to 20 Kcps (60 ips)
Signal to Noise Ratio	- 30 db from dc to 20 KC at normal recording levels
Input Impedance	- 50,000 ohms minimum
Adjustments	- Signal amplitude, center frequency, heat drive current

Direct Record - Model 1057A

Input Voltage	- 1 volt P.P. for normal record level
Frequency Response	- ± 2 db between 300 cps and 200 Kcps
Signal to Noise Ratio	- 30 db from 300 cps to 200 Kcps
Bias Signal	- 1 mc
Adjustments	- signal amplitude, bias amplitude, head tuning

V. Features

1. The DAQ-PAC is completely self contained and portable.
2. Simplicity - The system design is conventional, requiring a minimum of operator training. With proper preparation, installation can be accomplished in a matter of hours rather than days. All data is recorded in conventional format and may be reduced on any standard reproducing system.
3. Flexibility - Due to the modular design, a wide range of response and tape speed variations is available. Any mode of analog recording may be employed.

4. Updating - All of the components in the DAQ-PAC exceed the environmental requirements as specified. The system can be updated without obsolescence by installing modules of increased hardness as they become available. The least radiation tolerant components may be easily replaced after exceeding design tolerance limits in the course of field use. Thus maximum utilization of the overall system is obtained.
5. Ease of Field Setup - A test set is available for laboratory and field checkout and adjustment of the DAQ-PAC. For field operation the test set may be operated directly from the DAQ-PAC battery charge line eliminating the need of an auxiliary power source.

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June 21, 1966

Mr. T. Nelson
Systems Consultant
Box 1546
Poughkeepsie, New York 12603

Subject: DAQ-PAC
 Hardened Instrumentation System

Gentlemen:

As a result of your request for additional information regarding the subject which was described in the April 1966 Data Processing Magazine, we are pleased to supply the attached descriptive brochure.

Should you desire additional information, please do not hesitate to contact either Mr. J. Ferro of our technical staff or the undersigned.

Yours very truly,


Donn J. Barnhart
Manager of Marketing

DJB/lcm
encl.

